

### DETAILED ACTION

The amendment filed on 06/06/2011 has been entered.

#### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-22 and 25-26 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 2-16, 18, 19 20-22 and 25-26 are rejected due to their dependency upon claims 1 and 17.

Claim 1 recites "a diamond electron emission device comprised of, in part, a light emitting device comprising the cathode and another element of the light emitting device forming an electroluminescent junction with the cathode; wherein the light emitting device generates light at the electroluminescent junction by electroluminescence and at least a portion of the light irradiates through the cathode toward the electron face." The Examiner is unable to find support in the specification for an electroluminescent junction.

Claim 17 recites "an electron beam source utilizing a diamond electron emission device comprised of, in part, a light emitting device for irradiating the cathode, wherein the light emitting device and the cathode are disposed together in an electron gun; and

an anode separated by a space from said electron emission face; wherein the light emitting device comprises the cathode and another element of the light emitting device generates light at the electroluminescent junction by the electroluminescence and at least a portion of the light irradiates through the cathode toward the anode." The Examiner is unable to find support in the specification for an electroluminescent junction.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-22 and 25-26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites "a diamond electron emission device comprised of, in part, a light emitting device comprising the cathode and another element of the light emitting device forming an electroluminescent junction with the cathode; wherein the light emitting device generates light at the electroluminescent junction by electroluminescence and at least a portion of the light irradiates through the cathode toward the electron face." It is unclear to the Examiner what the Applicant means by light is generated by electroluminescent junction. For purpose of examination the Examiner interprets the claim limitation as describe in the specification: "a junction that is generated light and a portion of the light is converted into electron."

Claim 17 recites "an electron beam source utilizing a diamond electron emission device comprised of, in part, a light emitting device for irradiating the cathode, wherein

the light emitting device and the cathode are disposed together in an electron gun; and an anode separated by a space from said electron emission face; wherein the light emitting device comprises the cathode and another element of the light emitting device generates light at the electroluminescent junction by the electroluminescence and at least a portion of the light irradiates through the cathode toward the anode." It is unclear to the Examiner what the Applicant means by light is generated by electroluminescent junction. For purpose of examination the Examiner interprets the claim limitation as describe in the specification: "a junction that is generated light and a portion of the light is converted into electron."

Claims 2-16, 18, 19 20-22 and 25-26 are rejected due to their dependency upon claims 1 and 17.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-2, 6-7, 9-11, 16 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kampherbeek et al., (US. Pub: 2003/0178583 A1; hereinafter "Kamp") in view of Saito et al., (US. Pat: 6,267,637 B1) of record.

**Regarding claim 1**, Kamp ('583) teaches (in at least figs. 4, 10a, 11 and 12) an electron emission device comprising: a cathode (16) having an electron emission face; and a light emitting device (see figs. 11 and 12) comprising the cathode (16) and another element (17(2)) of the light emitting device forming a junction with the cathode (16); Kamp ('583) teaches ([0061]) photons from the light travel through the supporting substrate (17) and reach the semiconductor layer (16; i.e. the cathode) where they will generate electrons; Kamp ('583) further discloses ([0088]) the sublayer (17(2)) is made of a suitable fluorescent material selected to receive light in the W range and to convert the received UV photons into photons (i.e. photons at the junction of 17 (2) and 16) with larger wavelengths...A portion of these photons with larger wavelengths will travel to the photocathode array material (16) toward the electron emission face (10); and they will have enough energy to generate electrons with the photocathode array (16).

Kamp ('589) does not disclose the cathode emission face is made of diamond.

However, it is well known in the art to form cathode emission face with diamond because of its high electron emitting characteristics with low voltage. For instance, Saito ('637) teaches (in at least fig. 11) a diamond face electron emission device comprised of, in part, a cathode (26) having an electron emission face made of diamond

(col. 2, lines 24-31) for the purpose of having an electron emitting device which can sufficiently emit electrons (col. 1, lines 49-50).

At the time of the invention, it would have been obvious to one of ordinary skill in the art to contemplate of forming the cathode emission face of Kamp with diamond for the purpose of having an electron emission device that can sufficiently emit electrons with low voltage.

**Regarding claim 2**, Kamp ('589) as modified by Saito ('637) teaches (in at least fig. 11 of Saito) the light emitting device is made of diamond.

**Regarding claim 6**, Kamp ('589) as modified by Saito ('637) teaches the electron emission face of the cathode is hydrogen terminated (col. 11, line 41 through col. 12, line 13 of Saito).

**Regarding claim 7**, Kamp ('589) as modified by Saito ('637) teaches the electron emission face of the cathode is oxygen terminated (col. 11, line 41 through col. 12, line 13 of Saito).

**Regarding claim 9**, Kamp ('589) as modified by Saito ('637) teaches (in at least fig. 11 of Saito; fig. 4 of Kamp) the electron emission face of the cathode (26) contains a sharpened projection part.

**Regarding claim 10**, the phrase "wavelength of light emitted from said light emitting device includes 5-5.4 eV" does not structurally distinguish the claimed invention from the prior art as is required from an apparatus claim. See MPEP 2114. Furthermore, Saito's device is capable of doing that.

**Regarding claim 11**, the phrase “wavelength energy of light emitted from said light emitting device is equal to or greater than 2.0 eV” does not structurally distinguish the claimed invention from the prior art as is required from an apparatus claim. See MPEP 2114. Furthermore, Saito's device is capable of doing that.

**Regarding claim 16**, Kamp ('589) as modified by Saito ('627) teaches (in at least fig. 11 of Saito; see also fig. 11 of Kamp) the light emitting device (20) is composed as one unit with said cathode (26).

**Regarding claim 25**, Kamp ('589) as modified by Saito ('627) teaches (in at least fig. 11 of Saito; fig. 4 of Kamp) the electron emission face of the cathode (26 and 16) contains a sharpened projection part (19 of Kamp; not labeled in Saito); said light emitting device (20 of Saito) is made of diamond; and said light emitting device is composed as one unit with said cathode (26).

Claims 17, 18 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saito et al., (US. Pat: 6,267,637 B1) of record in view of Kampherbeek et al., (US. Pub: 2003/0178583 A1; hereinafter “Kamp”).

**Regarding claim 17**, Saito ('627) teaches (in at least fig. 11) an electron beam source utilizing a diamond electron emission device, comprising: a cathode (26) having an electron emission face made of diamond (col. 2, lines 25-30); and a light emitting device (20) for irradiating the cathode, wherein the light emitting device (20) and the cathode (26) are disposed together in an electron gun; and an anode (not labeled in fig. 11) separated by a space from said emission face; wherein the light emitting device comprises the cathode (26) and another element (26') of the light emitting device

forming a junction with the cathode, but silent about the light emitting device generates light at the junction and at least portion of the light irradiates through the cathode toward the anode.

Kamp ('583) discloses (in at least fig. 11) an electron emission device comprised of, in part, a light emitting device (7) comprises a cathode (16) and another element (17(2)) where the light emitting device generates light at the junction ([0088]; i.e. the photons with the larger wavelengths) and at least portion of the light irradiates through the cathode (16) toward the anode. At the time of the invention, it would have been obvious to one of ordinary skill in the art to contemplate of using the electron emission device structure of Kamp in the device of Saito for the purpose of having a device that can draw electrons with low driving voltage.

**Regarding claim 18**, Saito ('627) teaches (in at least fig.11) a voltage that is positive relative to said cathode is applied to the anode.

**Regarding claim 26**, Kamp ('589) as modified by Saito ('627) teaches (in at least fig. 11 of Saito; fig. 4 of Kamp) the electron emission face of the cathode (26 and 16) contains a sharpened projection part (19 of Kamp; not labeled in Saito); said light emitting device (20 of Saito) is made of diamond; and said light emitting device is composed as one unit with said cathode (26).

Claims 3-5, 8-15 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kampherbeek et al., (US. Pub: 2003/0178583 A1; hereinafter "Kamp") in view of Saito et al., (US. Pat: 6,267,637 B1) of record as applied to claims 1-

2, 6-7, 9-11, 16 and 25 above, in further view of Hirabayashi (US. Pat: 5,541,423) of record.

**Regarding claims 3 and 4,** Kamp ('583) as modified by Saito ('637) teaches all the claimed limitations except for the electron emission face of cathode is an n-type and p-type diamond semiconductor cathode.

Hirabayashi ('423) teaches (in at least fig. 1) an electron emission face comprised of, in part, an n-type and a p-type diamond semiconductor (abstract) for the purpose of providing a pn junction diamond semiconductor which can operate with a large electric current and which can exhibits superior pn junction characteristics, as well as high durability (col. 2, lines 44-48).

At the time of the invention, it would have bee obvious to one of ordinary skill in the art to use the pn junction diamond semiconductor of Hirabayashi in the device of Kamp as modified by Saito for the purpose of providing a pn junction diamond semiconductor which can operate with a large electric current and which can exhibits superior pn junction characteristics, as well as high durability.

**Regarding claim 5,** Kamp ('583) as modified by Saito ('637) and further modified by Hirabayashi ('423) teaches the p-type diamond semiconductor includes crystal defects (col. 7, lines 1-6).

**Regarding claim 8,** Hirabayashi ('423) teaches the light emitting device is composed of a pn junction of diamond (abstract). The reason for combining is the same as for claims 3 and 4.



**Regarding claim 12**, Kamp ('583) as modified by Saito ('637) and further modified by Hirabayashi ('423) teaches (in at least figs. 1-3) the light from the light emitting device excites electrons in an impurity level to a conduction band. Also, the claimed limitation does not structurally distinguish the claimed invention from the prior art as is required from an apparatus claim. See MPEP 2114.

**Regarding claim 13**, Kamp ('583) as modified by Saito ('637) and further modified by Hirabayashi ('423) teaches light from the light emitting device excites electrons in a band gap level to a conduction band. Also, the claimed limitation does not structurally distinguish the claimed invention from the prior art as is required from an apparatus claim. See MPEP 2114.

**Regarding claim 14**, Hirabayashi ('423) teaches the light emitting device excites electrons in a level resulting from any of following components of p-type diamond: non-crystalline carbon; diamond-like carbon; dislocation defect or grain boundary defect (col. 4, lines 57-68). The reason for combining is the same as for claims 3 and 4.

**Regarding claim 15**, Hirabayashi ('423) teaches the n-type diamond contains as an impurity at least one element among nitrogen, phosphorus, sulfur and lithium, or any one of the elements and boron (col. 3, lines 51-52). The reason for combining is the same as for claims 3 and 4.

**Regarding claim 20**, Hirabayashi ('423) teaches (col. 13-col. 14, line 14) the cathode comprises an n-type diamond (98) and the other element comprises a p-type diamond (97). The reason for combining is the same as for claims 3 and 4.

**Regarding claim 21**, Hirabayashi ('423) teaches (in at least figs. 2-3) the cathode comprises a p-type diamond (97) and the other element comprises an n-type diamond (98).

**Regarding claim 22**, Hirabayashi ('423) teaches (in at least fig. 1) the cathode comprises a p-type diamond (2) and the other element comprises a schottky electrode (3). The reason for combining is the same as for claims 3 and 4.

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kampherbeek et al., (US. Pub: 2003/0178583 A1; hereinafter "Kamp") in view of Saito et al., (US. Pat: 6,267,637 B1) of record as applied to claims 1-2, 6-7, 9-11, 16 and 25 above, in further view of Xie et al., (US. Pat: 6,204,597) of record.

**Regarding claim 19**, Kamp ('583) as modified by Saito ('637) teaches all the claimed limitations except for the control electrode is disposed between the cathode and the anode to regulate an emission electron current from the cathode.

Xie ('597) in the same field of endeavor teaches (in at least fig. 6) a diamond electron emission device comprised of, in part, a control electrode (126) is disposed between the cathode (118) and the anode (138) to regulate the emission electron current from the cathode.

At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the control electrode structure of Xie in the device of Kamp as modified by Saito in order to regulate the emission electron current from the cathode.

***Response to Arguments***

Applicant's arguments with respect to claims 1-22 and 25-26 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ELMITO BREVAL whose telephone number is (571)270-3099. The examiner can normally be reached on M-F (8:30 AM-5:00 Pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Toan Ton can be reached on (571)-272-2303. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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Primary Examiner, Art Unit 2889

August 15, 2011  
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